Notice No.1

Rules and Regulations for the Classification of Linkspans

July 2019

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: November 2019

Amendments to	Effective date	IACS/IMO implementation (if applicable)
Part 3, Chapter 5, Section 4	1 January 2020	N/A

Lloyd's Register

Part 3, Chapter 5
Bridge/Vehicle Ramp Strength

■ *Section 4*
Design criteria

4.3 Allowable stress - Plate buckling failure

4.3.2 For components subject to compression, the critical buckling stress is given by:

a. for $\sigma_{cb} < 0{,}5\sigma_y$

$$\cancel{\sigma_{cb} = K_c E\left(\frac{t}{b}\right)2} \qquad \sigma_{cb} = K_c E\left(\frac{t}{b}\right)^2$$

b. for $\sigma_{cb} \geq 0{,}5\sigma_y$

$$\cancel{\sigma_{cb} = \sigma_y\left(1 - \frac{\sigma_y}{4K_c E\left(\frac{t}{b}\right)2}\right)} \qquad \sigma_{cb} = \sigma_y\left(1 - \frac{\sigma_y}{4K_c E\left(\frac{t}{b}\right)^2}\right)$$

where

σ_{cb} = critical compression buckling stress, in N/mm^2

σ_y = yield stress, in N/mm^2

~~K_c = compression buckling constant, see Figure 5.4.1 Compression buckling constant Kc~~

E = Young's modulus, in N/mm^2

t = plate thickness, in mm

b = plate width, i.e. normal to direction of stress, in mm

K_c = compression buckling constant, defined as follows

for α ≥ 1:

$$K_c = \frac{\pi^2}{12(1-\mu^2)}\frac{8{,}4}{2{,}1} = 3{,}615$$

for α < 1:

$$K_c = \frac{\pi^2}{12(1-\mu^2)}\left(\alpha + \frac{1}{\alpha}\right)^2$$

where

$\alpha = \frac{a}{b}$

μ = Poisson's ratio

a = plate length, i.e. in the direction of stress

The graphical representation of K_c is provided in *Figure 5.4.1 Compression buckling constant K_c*.

4.3.3 For components subject to shear, the critical buckling stress is given by:

a. for $\tau_b < 0{,}29\sigma_y$

$$\cancel{\tau_b = K_s E\left(\frac{t}{b}\right)2} \qquad \tau_b = K_s E\left(\frac{t}{b}\right)^2$$

b. for $\tau_b \geq 0{,}29\sigma_y$

$$\cancel{\tau_b = 0{,}58\sigma_y\left(1 - \frac{0{,}58\sigma_y}{4K_s E\left(\frac{t}{b}\right)2}\right)} \qquad \tau_b = 0{,}58\sigma_y\left(1 - \frac{0{,}58\sigma_y}{4K_s E\left(\frac{t}{b}\right)^2}\right)$$

τ_b = critical shear buckling stress, in N/mm^2

σ_y = yield stress, in N/mm^2

~~K_s = shear buckling constant, see Figure 5.4.2 Shear buckling constant Ks~~

E = Young’s modulus, in N/mm^2

t = plate thickness, in mm

b = smallest plate dimension, in mm

K_s = shear buckling constant, defined as follows

for α ≥ 1:

$$K_s = \frac{\pi^2}{12(1-\mu^2)}\frac{8{,}4}{2{,}1} = 3{,}615$$

for α < 1:

$$K_s = \frac{\pi^2}{12(1-\mu^2)}\left(4{,}0 + \frac{5{,}34}{\alpha^2}\right)$$

where

$\alpha = \frac{a}{b}$

μ = Poisson’s ratio

a = plate length corresponding to b

The graphical representation of K_s is provided in *Figure 5.4.2 Shear buckling constant K_s*.

4.3.4 For components subject to bending stress, the critical buckling stress is given by:

a. for $\sigma_{bb} < 0{,}5\sigma_y$

$$\cancel{\sigma_{bb} = K_b E\left(\frac{t}{b}\right)2} \qquad \sigma_{bb} = K_b E\left(\frac{t}{b}\right)^2$$

b. for $\sigma_{bb} \geq 0{,}5\sigma_y$

$$\cancel{\sigma_{bb} = \sigma_y\left(1 - \frac{\sigma_y}{4K_bE\left(\frac{t}{b}\right)2}\right)} \qquad \sigma_{bb} = \sigma_y\left(1 - \frac{\sigma_y}{4K_bE\left(\frac{t}{b}\right)^2}\right)$$

σ_{bb} = critical buckling stress, in N/mm^2

σ_y = yield stress, in N/mm^2

~~K_b = bending buckling constant, see Figure 5.4.3 Bending buckling constant Kc~~

E = Young’s modulus, in N/mm^2

t = plate thickness, in mm

b = plate width, i.e. normal to direction of stress, in mm

K_b = bending buckling constant, defined as follows

for $\alpha \geq \frac{2}{3}$:

$$K_b = \frac{\pi^2}{12(1-\mu^2)}23{,}9 = 21{,}6$$

for $\alpha < \frac{2}{3}$:

$$K_b = \frac{\pi^2}{12(1-\mu^2)}\left(15{,}87 + \frac{1{,}87}{\alpha^2} + 8{,}6\alpha^2\right)$$

where

$\alpha = \frac{a}{b}$

μ = Poisson’s ratio

a = plate length, i.e. in the direction of stress

The graphical representation of K_b is provided in *Figure 5.4.3 Bending buckling constant* K_b.

4.4 Allowable stress – Joints and connections

4.4.1 For welded joints, the physical properties of the weld metal are considered as equal to the parent metal. For full penetration butt welds, ~~subjected to direct and shear stresses~~ the allowable stress is equal to the allowable ~~tensile~~ stress of the parent material (*see Pt 3, Ch 5, 4.1 Allowable stress – Elastic failure*).

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